Determining Optimal Strategy From Cost Perspective of Students Taking Actuarial Exams

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Hypothesis

The Society of Actuaries (SOA) routinely posts information on the pass rates of candidates attempting their exams. There is very little publicly available information on how candidates' pass rates from differing demographics vary from one another. This study looked at various factors of actuarial candidates on the university level and determined which factors likely contributed to their passing of actuarial exams. In addition, I looked at factors students have control over (i.e. number of study resources) to see if an optimal exam strategy can be obtained using a linear model.

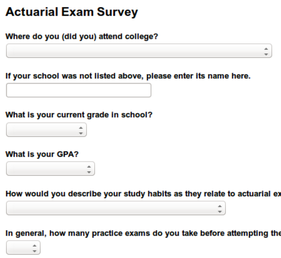

Figure 1: Excerpt of Questionnaire distributed to participants.

FACTORS TAKEN
General
College
GPA
Year in School
Study Habits
Practice Exam Habits
By Exam
How Many Attempts
Pass
Relevant Coursework
Study Resources Used

Table 1: Listing of factors asked in questionnaire

Experimental Method

I developed a questionnaire for potential participants to take putting emphasis on factors I hypothesized to be directly related to actuarial exam pass rates. Then, using the SOA listing of schools that had complete coursework for the first two exams I contacted the listed actuarial program director in order to distribute the online survey (made in Google Drive) among the departments' students. After three weeks, I closed the survey and downloaded a spreadsheet containing the responses. I formatted the raw data into binary responses using tools in Microsoft Excel and LibreOffice. I then computed the mean pass rates across the categories in Excel. Using the statistical analysis software R, I constructed linear and logistic regression models on most of the categories. I ran another regression using only statistically significant variables on the 10% level. The linear model of these results gave my final model. Finally, I tested the accuracy of these models using the fraction correctly predicted method.

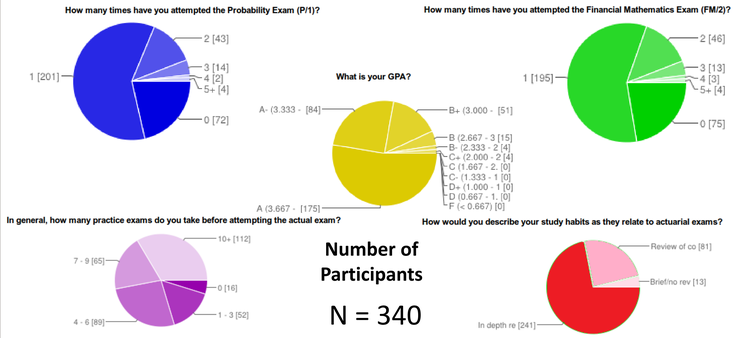

Figure 2: Summary of Responses. The numbers listed on the pie charts correspond to the participants' responses to the question.

Assumptions

A few assumptions were made when analyzing the data. First, it was assumed that general characteristics (GPA, study habits, etc.) remained constant for each attempt. This allowed me to use these data for each individual attempt for students who had multiple attempts listed. Second, it was assumed that the resources students used had a cumulative effect on pass rates, meaning resources used for one attempt were assumed to be used for subsequent attempts.

Figure 3: Comparing SOA reported pass rates and sample means

Factors Tested	Statistically Significant on 10% level
Multiple exams	No
Relevant Coursework	No
Number of Resources used	P
Center of Actuarial Excellence	P & FM
Non – US	P & FM
GPA	P & FM
Review Level	No
Number of Practice Exams	No

Table 2: Summary of statistically significant variables

Results

There were 340 responses overall. After omitting irrelevant data and reformatting, the number of attempts and sample pass rates for the Probability Exam (P) and the Financial Mathematics Exam (FM) were 348 and 65.8% and 347 and 65.7%, respectively. This is much higher than recently reported SOA pass rates (see Figure 3). Significant variables were related to the type of school the candidate attends, as well as GPA. Centers of Actuarial Excellence (CAE) (schools that pass certain educational requirements set by the SOA) had lower pass rates than non-CAE schools. Schools outside of the United States (mostly Canadian schools) had a significantly higher mean pass rate than those inside the US. Higher GPAs also had higher pass rates. These pass rates are summarized in Figure 4. For exam P, there is evidence to support that increasing the number of study resources used increases the likelihood of passing that particular actuarial exam. After running another regression on these significant variables, all resulting models were tested on the samples themselves. The trimmed linear models for P and FM were accurate 70.1% and 72.6% of the time, respectively.

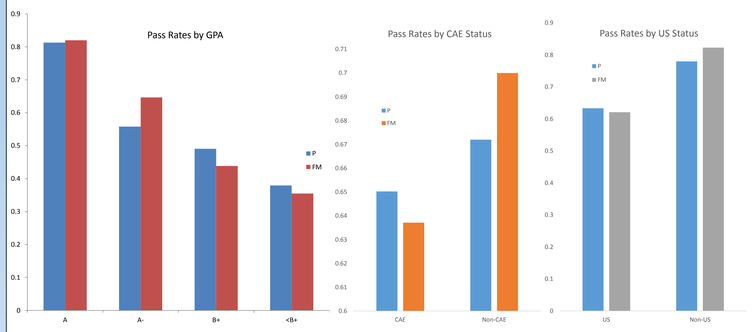

Figure 4: Sample Pass Rates, given statistically significant variables.

Model

$$Y_{PASS}^{P} = \beta_{INT} + \beta_{RES\#}X_{RES\#} + \beta_{CAE}X_{CAE} + \beta_{N\_US}X_{N\_US} + \beta_{A}X_{A}$$

$$Y_{PASS}^{FM} = \beta_{INT} + \beta_{CAE}X_{CAE} + \beta_{N\_US}X_{N\_US} + \beta_{A}X_{A} + \beta_{A-}X_{A-}$$

MODEL PARAMETERS			
P		FM	
Parameter	Estimate	Parameter	Estimate
INT	0.435	INT	0.4399
RES#	0.04436	CAE	-0.08278
CAE	-0.08766	N_US	0.21052
N_US	0.17832	A	0.39338
A	0.31189	A-	0.22665

Table 3: Values for linear model parameters (beta values).

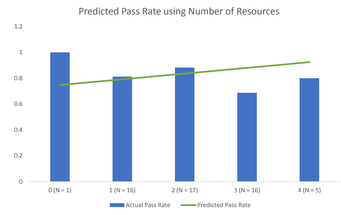

Figure 5: predicted and sample pass rates at different resource numbers for a sample UMN student (A average, non-CAE, and US).

Conclusion

Based on the data, there is evidence to support a divergence in average pass rates between university and non-university actuarial candidates. Further, within the university setting, it appears that having a strong GPA increases the likelihood of passing exams P and FM. School factors such as CAE and US status have a statistically significant effect on pass rates. Any explanation as to the reason behind these factors would only be speculation, therefore I recommend further testing and analysis to determine possible reasons for these trends. The only statistically significant (and only for exam P) factor that a student has immediate control of is the number of study resources used. There is evidence to support using more study resources will increase the likelihood of passing, but determining how these resources are used would be necessary before making any recommendation of optimal study strategy for any given student. Since the accuracy of the models is less than 75%, I would recommend looking for other variables that may better predict actuarial exam pass rates.

Literature Cited

http://www.soa.org/education/resources/actuarial-colleges/actuarial-college-listings-details.aspx

http://www.soa.org/education/general-info/exam-results/edu-exam-results-detail.aspx

Introduction to Econometrics, Third Edition; James H. Stock and Mark M. Watson

SAS and R Data Management, Statistical Analysis and Graphics; Ken Kleinman and Nicholas J. Horton

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